

SEPTEMBER 06, 2006

HHMI Opens the Doors to Discovery at the Janelia Farm Research Campus

What began as an idea sketched out on the back of a napkin has led—after six years of intense planning, construction, and recruiting—to the opening of the Janelia Farm Research Campus, a new scientific community created by the Howard Hughes Medical Institute (HHMI).

Janelia Farm, which is located in Ashburn, Virginia, is an environment where leading scientists can pursue long-term, high-risk, high-reward research in a campus specially designed to bring together researchers from disparate disciplines.

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— Thomas R. Cech

The opening of Janelia Farm is a watershed event in the history of this Institute, said HHMI President Thomas R. Cech. With the creation of this campus, HHMI has yet another venue from which to implement its core belief—that when creative, imaginative scientists are given the freedom, flexibility and support to pursue their dreams, they can change the world.

Like any scientific experiment, the specific discoveries that await us are difficult to predict. But we already know that the process of designing, planning and building this unique campus has been a successful collaboration among people of diverse technical and professional backgrounds from all over the world. That's what Janelia Farm is all about, Cech said.

Gerald M. Rubin, HHMI vice president and director of the Janelia Farm Research Campus, led the development of the scientific program and the recruitment of Janelia Farm scientists. The planning activities for the scientific program and for the campus facilities at HHMI's first freestanding

research campus were intertwined, with each part overlapping and influencing the other. The landscape building, the main research facility on the campus, features an undulating, terraced design, five acres of green roof and one of the world's largest installations of structural glass. The campus was designed by internationally renowned architect Rafael Viñoly.

The architectural designs of the buildings and the laboratories are aimed at achieving Janelia Farm's central objectives—collaboration and flexibility. HHMI's architect and senior facilities officer Robert H. McGhee, who is a gifted laboratory design architect, guided the planning of the unique research space. McGhee also wrote the facilities program, which outlined the requirements of the campus and the types of spaces that HHMI wanted to create inside the new buildings.

As the Janelia Farm campus opens its doors for discovery, 10 group leaders and six fellows—recruited from some of the best research institutions in the world—are eagerly anticipating their chance to work together on some of the toughest problems facing biologists. Each group leader will direct a research group of between two and six lab members, purposefully small to allow the group leader to continue being active in science. Each fellow will lead a group of up to two lab members. The group leaders and fellows will ultimately bring expertise from diverse fields, including biology, chemistry, computational biology, engineering, mathematics, neurobiology and physics.

When the campus is at full capacity in 2009, there will be 24 group leaders and about 20 fellows. The permanent research staff will number about 250 people and there will be up to 100 visiting scientists.

In 2004, after months of long discussions and meetings with leading experts in a variety of research fields, Rubin unveiled the two broad areas of scientific inquiry at Janelia Farm: discovering the basic rules and mechanisms of the brain's information-processing system, and developing biological and computational technologies for creating and interpreting biological images.

If you look at all the truly large, unsolved problems in biology, there is a very good chance that they will not be solved by one laboratory or by scientists in one discipline, said Rubin. These problems require interdisciplinary researchers like the team we have assembled at Janelia Farm.

The group leaders and fellows have already begun to form a close-knit scientific community that has set its sights on some ambitious projects: building new types of microscopes that will permit scientists to observe living cells in unprecedented detail; learning how the brain adapts and rewires in response to new experiences; deciphering which neurons control specific behaviors in the fruit fly *Drosophila melanogaster*; using protein design and computation techniques to create novel nanosensors that can be used in living organisms and cells; and understanding the physical mechanisms that neurons use to process and store information.

The environment at Janelia Farm will foster scientific interaction and promote collaboration. Chief operating officer Cheryl A. Moore and her staff

have developed an operational structure dedicated to creating a culture of collaboration and support that will help scientists focus on science. We have focused on creating a culture in which science can move forward, free from bureaucratic hassle, said Moore. To promote productive collisions, Moore and her staff have worked to foster an environment that will provide numerous opportunities for Janelia colleagues to meet one another. That may occur over lunch, during afternoon tea, in the evening at the campus's pub, while using shared scientific resources, or in the common stockrooms, but not in lengthy administrative meetings, said Moore.

Scientists at Janelia Farm will also have the opportunity to interact with colleagues from around the world who come to Janelia to attend selective, focused scientific conferences that are scheduled to begin in the fall of 2006. Kevin Moses, associate director for science and training, said the conferences will enrich the intellectual atmosphere at Janelia Farm. Janelia Farm has also established partnerships with the University of Cambridge and the University of Chicago to launch an interdisciplinary graduate program.

Janelia Farm will complement HHMI's flagship investigator program, which is directed by David A. Clayton, HHMI vice president and chief scientific officer. There are currently more than 300 HHMI investigators, who are widely recognized for their creativity and productivity. They carry out their research on the campuses of universities and other research organizations throughout the United States.

Rubin acknowledges that Janelia Farm responds to HHMI's concern that much of the research in the academic and industrial sectors has become too conservative. Traditional academic environments are suitable for a large proportion of research projects, but Rubin believes they can be too restrictive, stifling the kinds of creative, long-term projects that can lead to true breakthroughs. This is true, in part, he said, because the reliance on external funding sources forces scientists to define their research programs in advance when they apply for grants. By setting the course of a research plan up front, scientists are restricted in their ability to pursue questions and opportunities that arise during their studies.

The bulk of the scientific community is limited to projects that can be funded by peer-review committees, which tend to be very conservative, Rubin said. These grants have to be reviewed every three to five years. It makes it very difficult for people to take on high-risk, high-reward projects. To eliminate these restrictions at Janelia Farm, all research projects will be funded by HHMI, with no outside support.

The Idea Takes Shape

The plan for Janelia Farm grew out of an acknowledgment by HHMI leadership that some research problems might be better addressed in a place where small groups of researchers with different skills can work together without the barriers typically encountered at a university. Development of new tools to facilitate biological discovery, for example, can require diverse expertise. At universities, scientists from different fields are often

compartmentalized, and the criteria used to evaluate researchers by their departments may restrict collaboration outside those walls. Industry, on the other hand, may foster small-group research, but must focus on creating marketable technologies.

Cech initiated the process that culminated in the development of Janelia Farm in 1999, before formally taking over as president of HHMI. He invited Clayton and Rubin to a Boulder, Colorado, restaurant where the three discussed possible future directions for research at HHMI. On the back of a napkin, the three sketched out early plans for what would later become the Janelia Farm Research Campus.

In developing the concept for the campus, Rubin, Cech, and Clayton, and their advisers sought to create an environment where researchers from a variety of disciplines could work together on tough biological questions that could not be answered in the three to five years that most federally funded grants cover. Furthermore, they knew there was a need for a well-equipped laboratory facility where different groups of scientists could come together, each bringing some members of their research group, to collaborate for periods ranging from a few weeks to several years.

Researchers at Janelia Farm would be freed from most of the administrative, grant writing, and teaching duties that consume time at a university. This would permit them to be hands-on scientists who could spend the bulk of their days working at the bench or engaging in collaborative discussions.

In planning Janelia Farm, Rubin carefully studied the structure and scientific culture of other important research models at both academic and for-profit biomedical laboratories, including the Medical Research Council Laboratory of Molecular Biology (MRC LMB) in England and AT&T's Bell Laboratories in the United States. The MRC LMB and AT&T's Bell Labs are generally considered to have been the most successful research institutions in biology and electronics, respectively.

Though the MRC LMB and Bell Labs were different in many ways, they did have several things in common. Both institutions kept research groups small, and principal investigators worked at the lab bench. The single sponsor provided all funding—applying for outside grants was not allowed—and good support services and infrastructure were in place. Notably, said Rubin, both institutions evaluated their own people rather than rely on expert opinions from outsiders.

We think of this as an experiment, said Rubin. We don't have all the answers. We have a working hypothesis. We formulated the hypothesis by studying previously successful research institutions and analyzing what made them successful. Rubin points out that it is not HHMI's goal to duplicate any of the highly successful research institutes that currently exist, but to create something different and complementary. We may not get it exactly right at first, but we'll adapt. We'll revise the hypothesis, like any good scientist would do. Ultimately, he said, the success of the Janelia Farm approach could be measured by a deletion test. Twenty years from now, would the scientific

landscape look substantially different if Janelia Farm's contributions were to be deleted?

Campus Design and Architecture

Janelia Farm is built on a 281-acre parcel of land that lies along the Potomac River near Leesburg, Virginia. HHMI acquired the Janelia Farm property in 2000. In 2004, the Institute purchased Selden Island, an adjacent 400-acre property, bringing the total size of the campus to 689 acres.

The property is characterized by thick forests and a Georgian manor house (listed on the National Register of Historic Places) that sits atop a gentle slope that descends to the river at the northern boundary.

All aspects of the technologically advanced research center—the programs, the people, the design of the buildings and infrastructure—will stimulate the multi-disciplinary, team-driven research needed to advance medical science.

The campus design was itself a collaborative effort led by Rafael Viñoly and Robert H. McGhee, who is Institute architect and senior facilities officer at HHMI, with substantial input from Janelia Farm director Gerald Rubin. In a unique collaboration between architect and client, McGhee and Rubin met weekly with Viñoly's team over a two-year period to discuss, critique and refine the design of all aspects of the buildings and campus.

Viñoly, who heads the architectural firm, Rafael Viñoly Architects, PC, which is headquartered in New York City, was selected from a slate of distinguished architects during an architectural competition organized by McGhee at HHMI in 2001. Construction of the building was completed with Turner Construction, Inc., as the contractor; Jacobs Facilities, Inc., as the project manager; and The Mark Winkler Company as the owner's representative.

HHMI's Janelia Farm complex—which includes a laboratory building, conference housing, and apartments for visiting scientists—blends into the natural surroundings of the site and features highly flexible laboratory space that can be adapted easily to meet changing research needs. The centerpiece of the campus is a nearly 1,000-foot-long laboratory building, called the landscape building, which if stood on end would equal the size of an 85-story building. But its elongated, gently undulating design conforms to the site's existing topography, and the building is literally built into the gentle slope in the form of three descending planted terraces.

As a result, if one stands behind the landscape building, near the manor house, one has a clear, unobstructed view across the Potomac River into the verdant Maryland countryside. The terraces of the landscape building become an indistinguishable part of the sloping meadow below.

Beneath these terraces, the labs, support areas, offices, meeting rooms, and communal spaces are arranged in a three-level stack that is horizontally offset to follow the slope of the site. On the lowest level, overlooking the pond, is

the main entrance hall, including large areas for social functions, dining areas, and meeting rooms. The next level, which is above and to the south, contains a long open plan of lab benches, support spaces, and office clusters.

Floor-to-ceiling glazing on the northern boundary of the laboratories separates them from a circulation corridor running the length of the building and connecting to stairs and elevator banks that provide vertical circulation. The corridor's fully glazed walls and ceiling allow light to penetrate the labs and establish a visual connection to the landscape, while also providing access to office clusters and the open terraces that alternate along the length of the plan opposite the labs. The third level is identical to the second, although it is once again shifted further south.

All told, Janelia Farm will include about 760,000 square feet of space, housing the research laboratories and support areas, a conference facility that includes 96 rooms for short-term visitors, and a housing village for more than 100 long-term visitors.

The Howard Hughes Medical Institute

The Howard Hughes Medical Institute was established in 1953 by the aviator-industrialist. HHMI's principal mission is conducting basic biomedical research, which it carries out in collaboration with more than 70 universities, medical centers and other research institutions throughout the United States. Its more than 300 investigators, along with a scientific staff of more than 2,000, work at these institutions in Hughes laboratories. The Institute also has a philanthropic grants program that is strengthening science education and training, from elementary school through graduate and medical school. It also supports the work of biomedical researchers in many countries around the globe.

HHMI has an endowment of approximately \$16 billion. Its headquarters are located in Chevy Chase, Maryland, just outside Washington, D.C.